Pest Control using Bark Pesticide Applicator (BPA) in Citrus Plants

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Abstract. As a citrus pest, Toxoptera sp. is classified as the main pest because the impact of the attack causes losses to the quantity and quality of the yield. Alternative pest control within insecticides in addition to using a knapsack sprayer or power sprayer is using Bark Pesticide Applicator (BPA), which is a tool to apply systemic pesticides through citrus stems optimally and serves to improve the efficiency of controlling main pests, safe for natural enemies, and environmentally friendly. The study was conducted at the Experimental Farm of the Indonesian Citrus and Subtropical Fruits Research Institute, Batu City, East Java, Indonesia from January to May 2018. This study compared the effectiveness of pesticide application devices using BPA and Power Sprayer (PS). The treatment was arranged using a randomized block design and repeated ten times. The test results showed that the application of pesticides with BPA was able to control aphids up to 93.84 % while PS was only able to suppress 29.48 %. While the existence of natural enemies can be saved if the application of pesticides is carried out using BPA

Keywords: Environmentally friendly, increase efficiency and effectiveness, save natural enemy, Toxoptera sp.

1 Introduction

Citrus plants are one of the most widely consumed fruits because citrus fruits are a precious resource of nutrition that is beneficial for the human body, like vitamin C, Vitamins B, potassium, phosphorous [1]. On the other hand, the correct cultivation of Citrus can increase farmers’ income, because the agricultural sector can increase income, especially farmers [2, 3]. The agricultural sector is very important in the economy of most developing countries [4].

The constraints in cultivation are the presence of the distraction of pests and diseases that can reduce crop production and quality [5]. Citrus pests and diseases need attention because they can affect productivity and even crop failure, if not managed properly. Insect pests are human competitors in agricultural produce. The damage caused by pests is an important factor in decreasing crop productivity [6]. Species that mostly attack citrus crops include; Aphis spiraecola Patch1914, Aphis gossypi Glover 1877, and Toxoptera citricidus Kirkaldy 1907 [7, 8]. Among the various Plant Pest Organisms (OPT) Citrus, T. citricidus has the potential to be a major pest, because can cause significant damage to citrus due to its ability to vector Citrus Tristeza Virus (CTV) [9, 10].

Citrus Tristeza Virus (CTV) is a disease of citrus plants transmitted through the vector aphids (T. citricidus) [11, 12]. CTV is a disease in citrus plants that can be damaging or even deadly. This virus survey is based on visual external symptoms in foliage and fruit and internal symptoms characteristic of the bark [13]. Effective pest control efforts can be carried out when the pest population is still under control. Pest control can be done by mean so integrated pest control (IPM). IPM is part of agricultural practice which is a strategy to control the population of harmful organisms in crop production systems [14]. Excess use of insecticides causes the killing of other useful insects [15, 16]. Pesticides are an integral part of modern life used to prevent the growth of unwanted living pest organisms [17], so pest control technology with chemical insecticides needs to be substituted. One way to control that is more environmentally friendly. The method of controlling with the application of bark painting can help save natural enemies [18], the bark painting method was modified tool become a Bark Pesticide Applicator (BPA) device.

Bark Pesticide Applicator (BPA) is an optimal application of systemic pesticides through citrus plants that serves to

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improve the efficiency of main pest control, is safe for the presence of natural enemies, and environmentally friendly. The availability of pest control devices in fruit plants is expected to be more efficient, environmentally friendly, and easy to do so that users get more practical and effective results. At present, the development of spray equipment in the field tends to be less environmentally friendly because insects which are not targeted are directly dead by insecticides. In addition to the techniques or methods of applying insecticides with a power sprayer, some develop by application by injection by making holes in trees. Based on this, it is deemed necessary to conduct pest control research to determine the effectiveness of various spraying devices on the Citrus plant.

2 Methodology

The study consisted of two experiments done in the field. The Bark Pesticide Applicator (BPA Treatment A) used in this study is a modification of components that have been developed for the efficiency and effectiveness of insecticide application tools compared to the conventional developed spray tool (Power Sprayer Treatment B).

The design of the experiment was using Random Group, which was implemented in the Keprok (Citrus reticulata Blanco) block. Each treatment uses 100 plants, as blocks or groups. From each treatment was taken 20 plants were randomly determined as replicates of sample units. Before the first application, preliminary observations are carried out to determine the distribution of leaf aphids on sample plants in the garden, to ensure that the effectiveness of the pesticide application is carried out according to the testing rules. The application of insecticide for treatment B uses the recommended dosage and method of application, whereas treatment A uses the dosage and application method as previously developed.

After treatment, 24 h later the Toxoptera sp. at four shoots originating from the four cardinal directions, for each sample unit. Observations were made at intervals of 1st d until the 3rd d, the next was conducted at intervals of 1st wk, until the 6th wk. The study was conducted at the Experimental Garden of the Indonesian Citrus and Subtropical Fruit Research Institute, Batu, Malang, East Java, Indonesia, from January to May 2018.

3 Results and discussion

From the field test results, it can be seen that the insecticide applied by the two treatment methods showed significant differences. In the observation of average fluctuations of aphids insect population, it was seen that the systemic insecticide applied purely on the stem showed different persistence, meaning that in the treatment applied with BPA, aphids mortality tended to increase until the 6th d and reached 100 %. Whereas in spray application using a Power sprayer, aphids mortality on 6th d only reached 29 % (Table 1).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mortality (%) treatment of brown aphids (Toxoptera sp.) after application</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Days to 1</td>
</tr>
<tr>
<td>BPA</td>
<td>2.97</td>
</tr>
<tr>
<td>Power Sprayer</td>
<td>0.63</td>
</tr>
</tbody>
</table>

From the Table 1 above, it can be seen that treatment with BPA (A), aphids mortality runs like a linear straight line, wherewith the concentration of the active ingredient dimethoate 4 cc tree⁻¹, the mortality of aphids can be reached 100 % on the 6th d. This proves that the speed with which the active ingredients are used in killing aphids is very dependent on the type of active ingredient and its concentration. The entry of insecticides into the insect's body depends on the formulation used. The susceptibility of organisms to most insecticides is due not only to share the same neurological and respiratory mechanisms as insects but also to lacking proper detoxification systems [19]. Effects insecticides depend on factors dose as a key determinant of elicited response [20]. In a field situation, the pesticide dose to which the insect is exposed will differ greatly over space and time. The degradation properties of pesticides are different from decontamination. Pesticide degradation rate is influenced by chemical factors and hydrogen concentration peroxide [21]. Acceleration of the degradation process results in decontamination.

In observation of the population of aphids on the Power Sprayer (B) treatment plot on the 6th d, the average mortality of 29 %, but on the following day, the population began to increase again. This means that the effectiveness of insecticides exposed to plant parts for 6 d begins to decrease so that the ticks can reproduce again, while insecticide application with BPA tools, on the 6th to 16th d the aphids no does not appear again in young shoots, meaning that the
insecticide applied through the stem causes the insecticide persistence in the plant for a long time. Thus it is proven that the application of bark painting using the BPA tool can be more effective and efficient.

Observations of the presence of natural enemies of the Coccinellidae family of aphids indicated normal conditions for feeding and breeding activities. In the plots that were applied using the BPA tool, it was seen that the population was higher than the plants applied using the Power Sprayer (PS) on the plant canopy. Natural enemies (predators) have a role in suppressing the pest (*T. citricidus*) population in the field [22, 23]. Egg colonies from natural enemies of the Coccinellidae group were mostly found in treatment plot A (Figure 1).

![Figure 1: The presence of natural enemies of the Coccinellidae family aphids on citrus plants in the field.](image1)

Efficiency can be seen from the amount of liquid attached to the plants. In the treatment of the Power sprayer, the liquid that drips during application is visible. The application of insecticide application on citrus plants aged 5 yr, the results of the calibration of the tool, and the suitability of the material applied were the average volume of the solution needed to be sufficient 500 L ha⁻¹, but in reality on the ground, farmers sprayed an average of more than 750 L ha⁻¹. From the practice carried out by farmers, the field shows that the amount of liquid that falls is more than 250 L ha⁻¹.

In the BPA treatment, the liquid attached to the stem of the plant, according to the size of the volume of liquid that comes out and is expected to drip a little, because the distance of the tip of the nozzle with the application field is only 7 cm to 9 cm (Figure 2).

![Figure 2: Distance between the nozzle and the rod 7 cm to 9 cm](image2)
Judging from the calculation of the cost per hectare shows a very real difference. The need for insecticide is the same every month, namely 1 600 mL ha⁻¹. However, seen from the energy required, it is very real that in the treatment of BPA applications the time and energy required in one month is quite efficient (Table 2). In 1 mo, the power sprayer treatment takes two people in 5 h, while with the application of insecticides with BPA it takes one person for 2 h. The efficiency of farming costs determines the income or profit of the farm. Income is calculated from the gross inflow of activities during a period [24]. Factors that have a significant effect against production pesticides and labor [25].

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Needs (cc ha⁻¹)</th>
<th>Time (h)</th>
<th>Interval (mo⁻¹)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPA</td>
<td>1.66</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Power Sprayer</td>
<td>400</td>
<td>5</td>
<td>4</td>
<td>20</td>
</tr>
</tbody>
</table>

4 Conclusion

The Bark Pesticide Applicator (BPA) application tool is proven to be more efficient in the use of time and power, as well as environmentally friendly in controlling citrus leaf aphids in the field. BPA is a systemic application of pesticides through citrus plant stems, which optimally functions to improve the efficiency of main pest control, safe for the presence of natural enemies, and environmentally friendly. The test results showed that the application of systemic insecticides on the stems of tangerines using BPA, was more effective and efficient in controlling the aphids of *Toxoptera* sp. With a concentration of 4 mL stem⁻¹ which is applied purely with a BPA device capable of controlling and suppressing aphids for up to 16 d, while applications with a power sprayer can suppress aphids for only 6 d. Application time for a 5 yr old citrus orchard covering an area of 1 ha, with a BPA device is only 2 h, whereas for a power sprayer the time required is 5 h.

Control with BPA can support an environmentally-friendly control program, because the presence of natural enemy populations of the Coccinellidae more survivors, compared to insecticide applications using a power sprayer in a plant canopy.

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